

# Where is the jet quenching in $Pb + Pb$ collisions at 158 AGeV? \*

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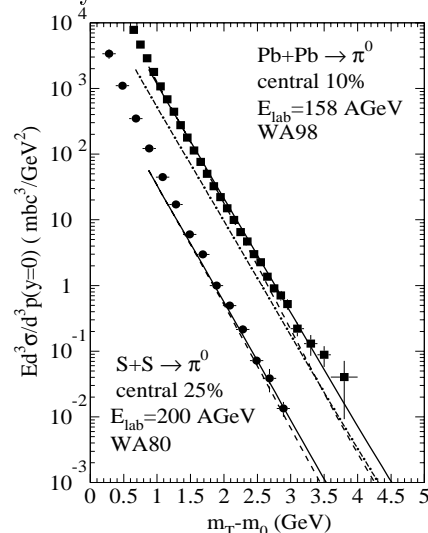
Like other hard processes, large transverse momentum parton jets are produced in the early stage of high-energy heavy-ion collisions. They often have to travel through the dense matter produced in the collisions and finally hadronize into high- $p_T$  particles in the central rapidity region. Recent theoretical studies show that a fast parton will lose a significant amount of energy via induced pQCD radiation when it propagates through a dense partonic matter where the so-called Landau-Pomeranchuk-Migdal coherence effect becomes important. If this picture of parton energy loss can be applied to large transverse momentum parton jets in the central rapidity region of high-energy central  $A + A$  collisions, one should expect a leading parton to lose energy when it propagates through a long-lived dense matter. Since the radiated gluons will eventually become incoherent from the leading parton which will fragment into large- $p_T$  hadrons, one then should expect a reduction of the leading hadron's  $p_T$  or a suppression of the large- $p_T$  particle spectrum. At the CERN SPS energy, high- $p_T$  jet or particle production ( $p_T > 3$  GeV/ $c$ ) is very rare and the power-law-like spectrum is very steep because of the limited phase space. It should be especially sensitive to any finite energy loss.

Shown in the figure are the calculated single-inclusive spectra for  $\pi^0$  in central  $S + S$  ( $E_{lab} = 200$  GeV) and  $Pb + Pb$  ( $E_{lab} = 158$  GeV) collisions with (solid) and without (dashed) nuclear  $k_T$ -broadening as compared to WA80 and WA98 data. Besides small effects of the nuclear modification of the parton distributions on the spectra at these energies, the dashed lines are simply the spectra in  $p + p$  collisions multiplied by the nuclear geometrical factor. It is clear that one has to include the  $k_T$ -broadening due to the initial multiple scattering in order to describe the data.

One can conclude from this analysis that the factorized pQCD parton model seems to work well for large- $p_T$  hadron production in  $A + A$  collisions. But there is no evidence of parton energy loss. This is in direct contradiction with the current theoretical studies of parton energy loss

in dense matter and calls into question current models of energy loss. It also implies that there is not a dense partonic matter which exists long enough to cause parton energy loss.

This implies that either the life-time of the dense partonic matter is very short or one has to re-think about the problem of parton energy loss in dense matter. The hadronic matter does not seem to cause jet quenching in  $Pb + Pb$  collisions at the CERN SPS. High- $p_T$  two particle correlation in the azimuthal angle is proposed to further clarify this issue.



Single-inclusive  $\pi^0$  spectra in central  $S + S$  at  $E_{lab} = 200$  GeV and  $Pb + Pb$  collisions at  $E_{lab} = 158$  GeV. The solid lines are pQCD calculations with initial- $k_T$  broadening and dashed lines are without. The dot-dashed line is obtained from the solid line for  $Pb + Pb$  by shifting  $p_T$  by 0.2 GeV/ $c$ .

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